ARTICLE 1 ANNALS OF CARNEGIE MUSEUM VOLUME 39

CHIRINDIA FROM TANGANYIKA (AMPHISBAENIA, REPTILIA)

[Notes on amphisbaenids no. 19]

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INTRODUCTION

Laurent's (1947:54) resurrection of the genus *Chirindia* Boulenger (1907:48) included seven species therein: *mpwapwaensis* Loveridge (1932), *ewerbecki* Werner (1910), *rondoensis* Loveridge (1941), *orientalis* Sternfeld (1911), *bushbyi* Cott (1934), *swynnertoni* Boulenger (1907), and *langi* FitzSimons (1939). Four of the type localities (those of *mpwapwaensis, ewerbecki, rondoensis,* and *orientalis*) were in Tanganyika and the remaining three in Mozambique, Rhodesia, and the Transvaal, respectively. Loveridge (1962) recently described two additional and quite similar species (*newalaensis* and *nanguruwensis*) from the southern portion of Tanganyika. This yielded a rather interesting situation with five species described from a single region less than 200 kilometers across.

As the three forms from southern Africa were described from one or two specimens each and the only additional records are those of Broadley (1963:15; 1964:1), knowledge of the group as yet is based on a total of ten specimens. The astonishing efforts of Mr. C. J. P. Ionides have now made available large series from various localities in southern Tanganyika, which in conjunction with materials collected earlier by Mr. A. Loveridge provide an excellent representation for that area. This makes it most practical to begin the review of this genus with a reconsideration of the Tanganyika material.

We are grateful to the following curators of institutions (identified throughout by the abbreviations given in parentheses) for permission to borrow or examine specimens in their care: Drs. Charles M. Bogert and Richard G. Zweifel, and Mrs. Margaret Bullitt, of the American Museum of Natural History (AMNH); Miss Alice G. C. Grandison of the British Museum (Natural History) (BM); Carl Gans collection,

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Buffalo (CG); Dr. Robert F. Inger of the Chicago Natural History Museum (CNHM); Dr. C. Kosswig, Naturhistorisches Museum, Hamburg (HM); Mr. R. Wagstaffe, of the Liverpool City Museum, England (LCM); Dr. Ernest E. Williams, of the Museum of Comparative Zoology (MCZ); Dr. Hobart M. Smith of the University of Illinois Museum of Natural History (UIMNH); Dr. Charles F. Walker of the University of Michigan Museum of Zoology (UMMZ); and Drs. H. Wermuth and G. Freytag, Zoologisches Museum der Universität, Berlin (ZMU). Mr. C. J. P. Ionides furnished detailed locality data on the specimens collected by him, and Miss Leona Allison spent much effort in preparing the drawings. This paper is one of a series supported by National Science Foundation grants NSF G-9054 and G-21819. Terminology and description follow Gans and Alexander (1962).

Comments on the Localities

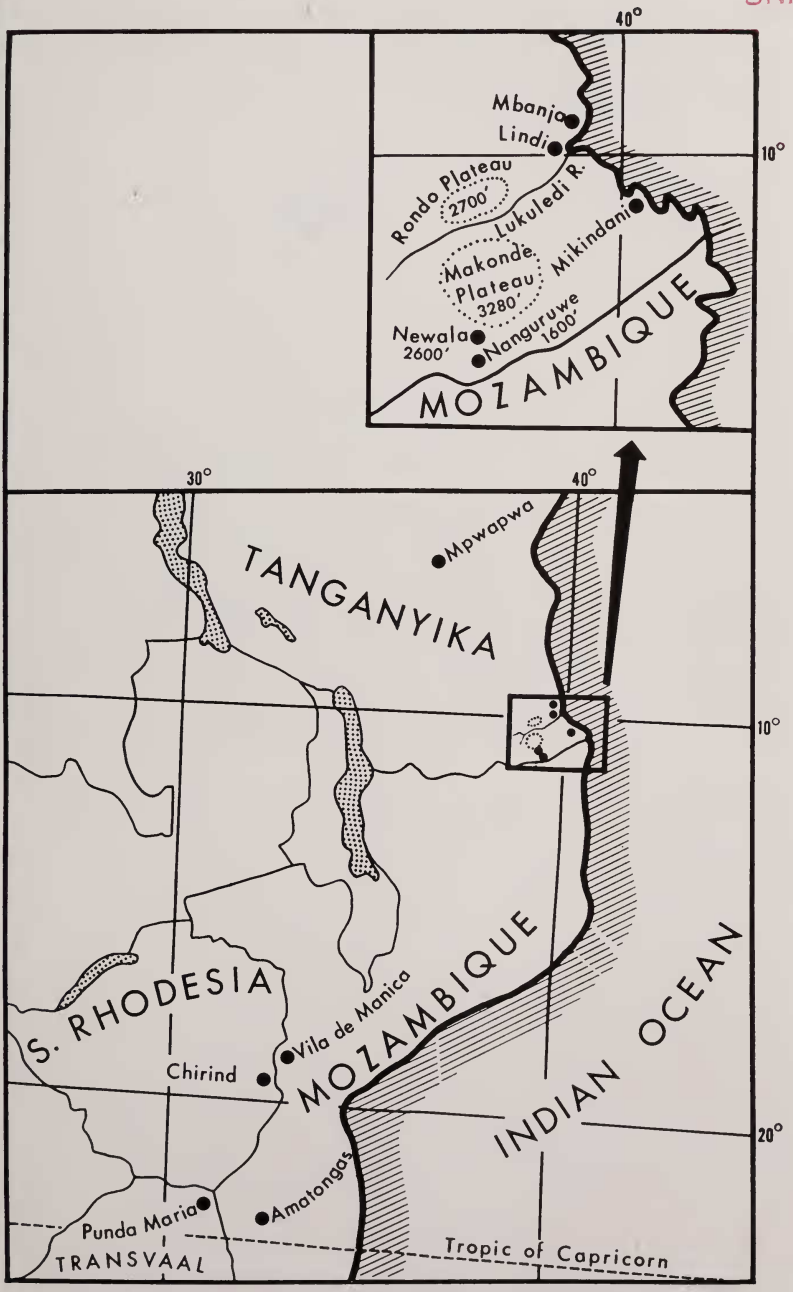
Loveridge (1933:304; 1937:495; 1944a:108) notes that the Mpwapwa specimens were collected at 3312 feet, in dry earth beneath a fallen tree close to a stream, in an association referred to as "upland savanna."

The specimens from Mbanja, Lindi, and Mikindani (see fig. 1 for map) were collected between sea level and 100 feet, at localities on the palm-bearing sandy plain in close proximity to the ocean (Loveridge, 1937: 493), and others in the red laterite coastal soils (Loveridge, 1941: 393, 396).

The locality of Nanguruwe is eight miles south of Newala, as confirmed by Mr. Ionides. The name Nanguruwe means "Place of Pigs" and is a common one for settlements in the area. The elevation at which the material was collected is 1600 feet as checked with the records of the Makonde Water Corporation.

Newala is indicated as lying on the edge of the highest point of the Makonde plateau at an elevation of 2600 feet (Loveridge, 1962:3; confirmed by Ionides in a personal communication). Mr. Ionides kindly informs us that the large series of amphisbaenids from this locality were all collected on his flat 10-acre plot. This is extremely important since the series appears to include two forms. Both Nanguruwe and Newala were once covered with primary rain forest, now cut down and replaced with secondary bush and areas of cultivation.

Fig. 1. *Chirindia.* Sketch maps of East Africa showing localities mentioned in the text. The insert map serves as the unit in fig. 3.



The Rondo plateau also rises to 2700 feet and lies approximately 60 air miles to the north, across the valley of the Lukuledi river. Specimens are available from Nchingidi and Mtene, the former forested site discussed by Loveridge (1944b:207), the latter not found on available maps.

General Characteristics of Tanganyika *Chirindia*

The various samples from Tanganyika resemble each other in a constellation of characters. All have a relatively elongate, slender body of small over-all size, and belong among the smallest amphisbaenids. A variable number of the dorsal head shields are fused, providing a cap of elongate shields from rostral to or beyond the level of the angulus oris. The snout is either rounded or pointed, the shape subject to ontogenetic change. The posterior aspect of the head, in diameter, is equivalent to the trunk, and there is little if any nuchal constriction. The lower jaw also is covered with relatively few, but enlarged shields. The mental appears as a truncated triangle, is posteriorly elongate, and contacts the very small rectangular postmental. Its sides are flanked by the enormous first infralabials, which are the largest segments of the lower jaw. The malars are small, wide, and relatively short.

The trunk, a circular cylinder in shape, retains a constant diameter up to the level of the cloaca. Thereafter the circular tail is slightly narrower for the anterior two-thirds of its length and then gradually becomes constricted to the conical caudal tip. Only the first four to six annuli are modified, the trunk annulation thereafter being regular (with extremely few exceptions). Intercalated dorsal half-annuli are found only in the immediate vicinity of the cloaca.

The lateral sulci are clearly marked; the dorsal and ventral ones are indicated only by an alignment at the intersegmental sutures.

At midbody the dorsal segments are slightly longer than they are wide. The midventral segments are approximately one and one half times as wide as long. The cloacal region is characterized by six (occasionally five) precloacal pores in males, and none in females and immature specimens, in which the segments of this region are somewhat wider, numbering two to four rather than the five to six seen in males.

The pigmentation of preserved specimens consists of a light-brown ground color with a darkening effect produced by an irregular distribution of pigment, seen as discrete spots (melanophores?) under the dissecting microscope. The pigment pattern involves a dorsal countershading that drops out at a variable level along the sides, with a few

specimens showing a pigmented ventral surface. The head and anterior fifth of the trunk lack pigmentation, which increases gradually thereafter. The tail, with dorsal and ventral surfaces pigmented, is easily the darkest region of the animal, and the caudal tip is particularly marked. The autotomy annulus also is darkened.

All specimens show caudal autotomy at the eighth to twelfth postcloacal annulus, a level near the end of the first third of the relatively long tail.

We differ with Loveridge (1957:237) in retaining these specimens in the genus *Chirindia,* a decision influenced by the cranial characteristics emphasized by Vanzolini (MS.; 1951:116), who saw skulls of *mpwapwaensis, orientalis, ewerbecki,* and *rondoensis* (now in MCZ collection). These forms of *Chirindia* certainly represent a natural group. For the moment it is immaterial whether this is recognized by generic or subgeneric status.

VARIATION OF CHARACTERS

GENERAL

The northernmost sample (N=2) comes from Mpwapwa and is clearly the most distinct in that both specimens retain an ocular shield, lost in all other samples. The specimens also are slightly larger and stouter bodied than are those from the southern localities, have significantly higher numbers of dorsal and ventral segments to a midbody annulus, and have several other differences.

The samples available from the southern area may be lumped for the zones of Mbanja-Lindi, Mikindani, Nanguruwe, Newala, and the Rondo Plateau (Mtene, Nchingidi, Rondo). These samples are compared on the basis of selected characters. Preliminary inspection of the data indicates that a large sample from Newala shows a bimodal distribution of body annuli and an associated bimodality of number of segments to a midbody annulus (fig. 2). This suggests that the sample is composite and sampled from two distinct populations. The groupings thus separated are hereafter referred to respectively as Newala-high and Newala-low.

Each sample may be characterized by a particular constellation of characters that were found to exhibit geographic variation (figs. 3 and 4). Interestingly enough the intersample differences are generally quite small.

BODY ANNULI

The samples fall into two groupings with counts ranging respectively

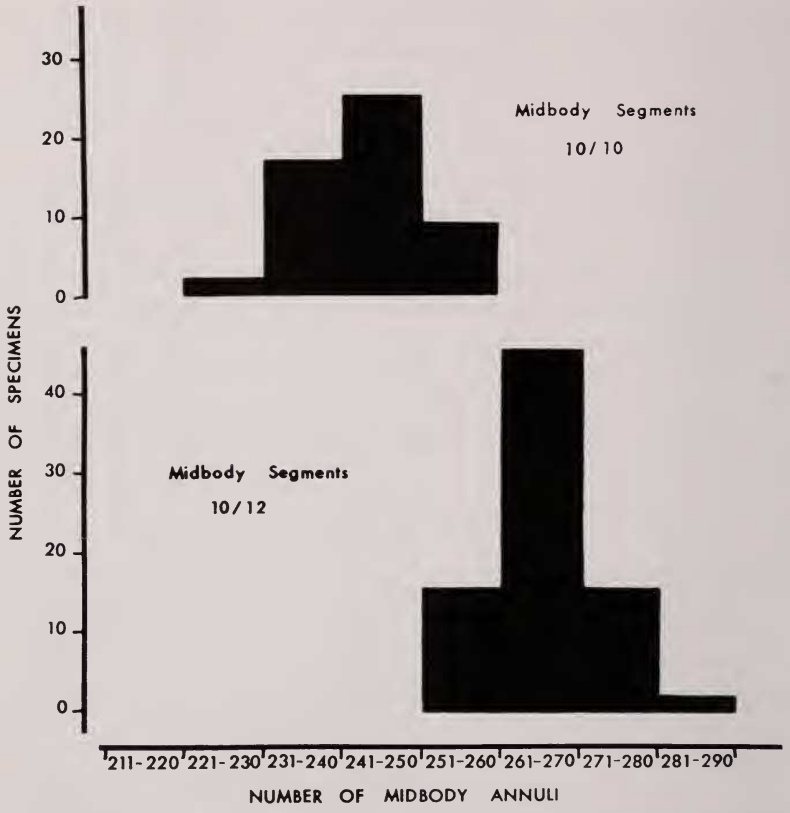
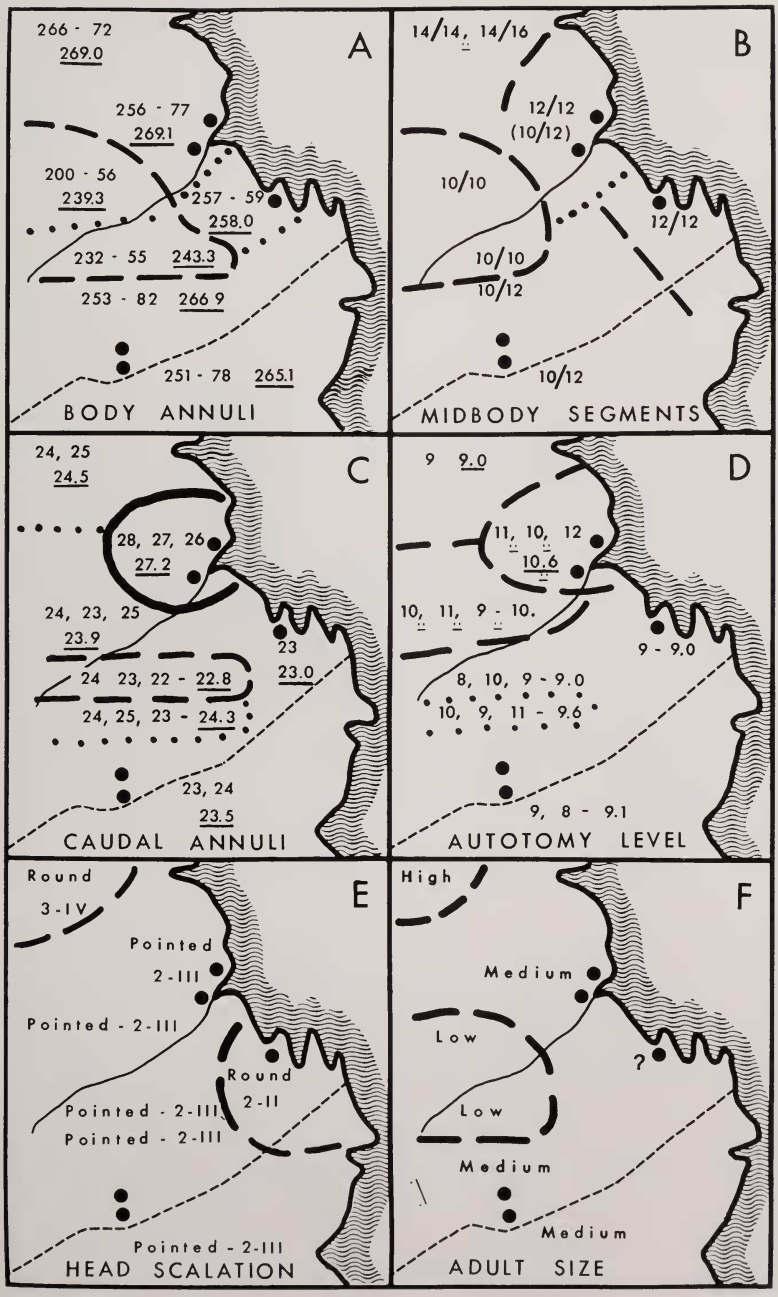
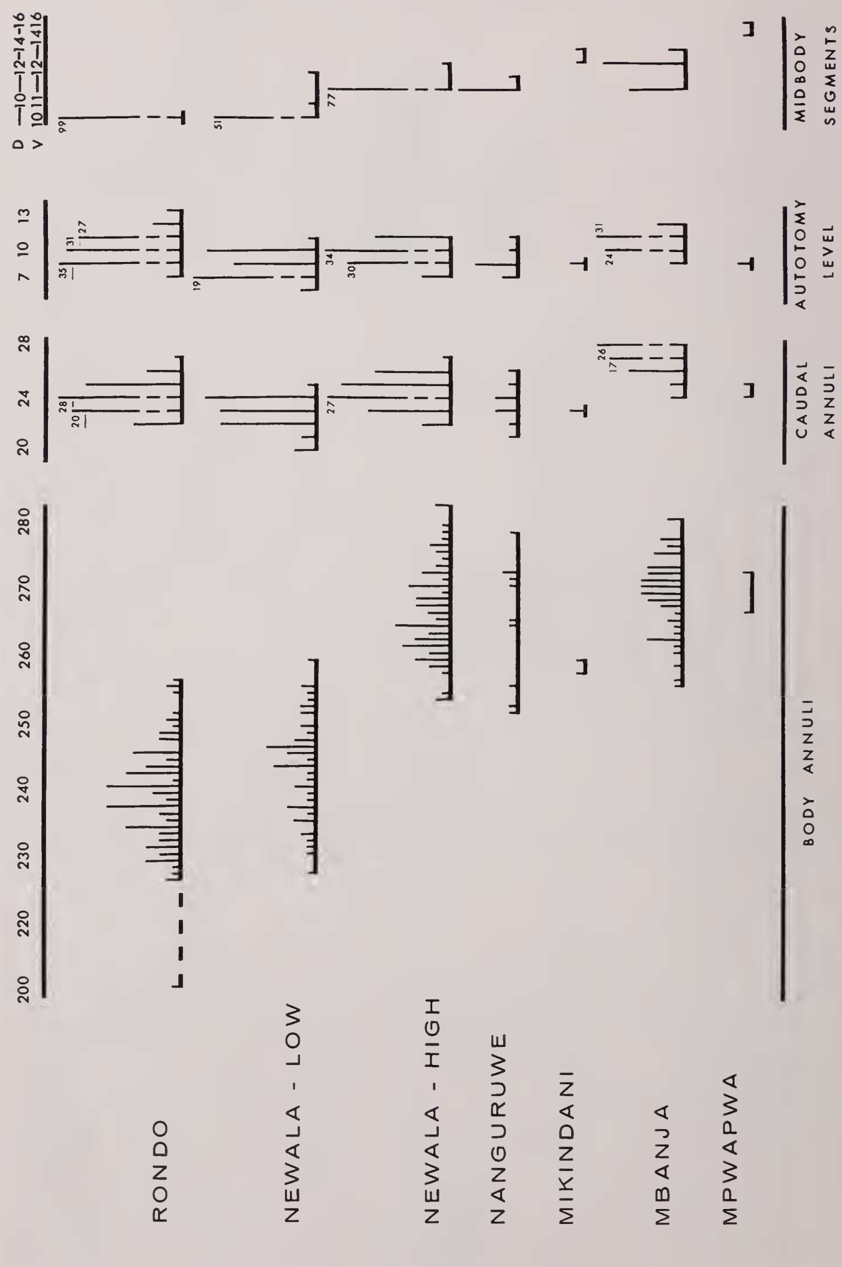


Fig. 2. *Chirindia.* Histogram of the Newala sample showing distribution of number of body annuli for specimens with, respectively, 10/10 and 10/12 (dorsal over ventral) segments to a midbody annulus.

Fig. 3. *Chirindia.* Sketch maps of the southern portion of Tanganyika showing the variation of the several characters. The heavy dashed and dotted lines give an approximation of the degree of difference between the samples. A. Number of body annuli, ranges and means (underlined). B. Number of segments (dorsal/ventral) per midbody annulus. Only the modal class is given. C. Number of caudal annuli, first three classes in order of frequency and mean (underlined). D. Caudal autotomy level, major classes in order of frequency and mean (underlined). E. Head scalation pattern. Indicated for each sample is the head shape (pointed or round), the number of supralabials (2 or 3), and the number of segments in the first postgenial row (II, III, or IV). F. Relative adult size based upon maximum length (low, medium, high). Note that all these forms are actually quite small.


266 - 72
269.0
256 - 77
269.1
200 - 56
239.3
257 - 59
258.0
232 - 55
243.3
253 - 82
266 9
251 - 78
265.1
A
BODY ANNULI
14/14, 14/16
12/12
(10/12)
10/10
12/12
10/10
10/12
10/12
B
MIDBODY SEGMENTS
24, 25
24.5
28, 27, 26
27.2
24, 23, 25
23.9
24 23, 22 - 22.8
24, 25, 23 - 24.3
23
23.0
23, 24
23.5
C
CAUDAL ANNULI
9 9.0
11, 10, 12
10.6
10, 11, 9 - 10.
9 - 9.0
8, 10, 9 - 9.0
10, 9, 11 - 9.6
9, 8 - 9.1
D
AUTOTOMY LEVEL
Round
3-IV
Pointed
2-III
Pointed - 2-III
Round
2-II
Pointed - 2-III
Pointed - 2-III
Pointed - 2-III
E
HEAD SCALATION
High
Medium
Low
?
Low
Medium
Medium
F
ADULT SIZE


RONDO
NEWALA - LOW
NEWALA - HIGH
NANGURUWE
MIKINDANI
MBANJA
MPWAPWA
BODY ANNULI
200 220 230 240 250 260 270 280
CAUDAL ANNULI
20 24 28
AUTOTOMY LEVEL
7 10 13
MIDBODY SEGMENTS
D —10—12-14-16
V 10 11—12—1416
99 51 77
35 31 27 19 34 30 24 31
28 20 27 26 17

from 225 to 255, and from 250 to 280, though a few indviduals exceed these ranges. Material from Mpwapwa, Mbanja, Lindi, and Nanguruwe, and Newala-high shows the high counts, while that from Newala-low and the Rondo Plateau shows the low counts. Sample means, Rondo versus Newala-low, and Mbanja versus Newala-high, differ by values of more than ten though this difference does not appear to be statistically significant. The Mpwapwa sample shows no significant difference from that from Mbanja, and the Nanguruwe sample is similarly close to Newala-high. The two specimens from Mikindani have values falling near the bottom of the high-count range.

CAUDAL ANNULI

The number of caudal annuli varies between 20 and 28. Since most samples have specimens in at least six of the nine possible categories there exists a considerable overlap (fig. 4). Differences are nevertheless marked, since better than 90 per cent of the records of any one sample normally fall within three adjacent classes. The maps, (fig. 3) show the first three classes (i.e., mode and next two classes) in order of frequency, followed by the sample mean.

The Mbanja sample has the highest counts; none of its first three classes occur with equal frequency in any other sample. It clearly is the most distinct. The two specimens from Mpwapwa and those from Mikindani show no overlap whatever with it, but agree quite well with the Nanguruwe and Newala-high samples. Inspection shows that the Newala-high and Newala-low samples differ in range and central tendency even though their mode is the same. The sample from Rondo agrees better with Newala-high than Newala-low though the Rondo mean is but slightly lower than that of Newala-high.

AUTOTOMY LEVEL

The ranges for this character are slightly smaller than those for the number of caudal annuli, which probably reflects the lower absolute values. (It should also be noted that the numbers of specimens available for this character are significantly greater than those for caudal annuli, since the autotomy level can still be determined on specimens with autotomized tails.)

It is interesting that the Mbanja sample, though still possessing the highest mode and mean, has its range and classes of highest frequency

Fig. 4. *Chirindia.* Diagram showing frequency distribution for four characters for the several samples.

overlapping those of some of the other samples. There are again marked differences between Mbanja-Mikindani and Mpwapwa, and between the two Newala samples. Mikindani and Nanguruwe are in good agreement, while the latter seems in this character closer to the Newala-low sample, with the Newala-high sample reminding of the slightly distinct one from the Rondo plateau.

The pattern of variation suggests an incomplete correlation between caudal counts and autotomy level. Here as in the Antillean amphisbaenids (Gans and Alexander, 1962) the site of the autotomy level seems to be influenced first by a factor inherent in the particular population and only secondarily by the relative number of caudal annuli.

NUMBER OF SEGMENTS TO A MIDBODY ANNULUS

This character provides one of the easiest and most rapid means for initial diagnosis within this group. Most of the large samples have nearly 95 per cent of their specimens within a single class, a degree of stability that does not seem to be unusual for amphisbaenid populations with low numbers of midbody segments.

The Mpwapwa sample clearly has the highest counts. The Mbanja and Mikindani samples come next. The former is the only sample of which more than 10 per cent of the specimens belong to a second class (13 per cent for 10/12) different from the mode (12/12). This second class agrees with the mode of the Nanguruwe and Newala-high samples. The Newala-low sample agrees with that from the Rondo Plateau.

HEAD SHAPE

There are two general head shapes. In the first the head is more or less rounded with the snout almost as wide and high as the posterior portion of the head, and the rostral tip extending but slightly beyond that of the lower jaw. This is shown by the Mpwapwa and Mikindani samples.

The second type reflects a much more pointed head with a marked prognathous snout. This is shown by the remaining samples.

It should be noted that the composite nasal-labial-prefrontal shield tends to be swollen in some specimens and (due to the vagaries of preservation) somewhat shrunken in others, thus producing intra-series differences. Other intra-series differences are due to the demonstrated ontogenetic change in head shape (Gans and Alexander, 1962). The observed geographical differences are not due to these factors.

DORSAL HEAD SCALATION PATTERNS

All specimens retain a rostral though the nasal on each side has

fused with the first infralabial(s) and the prefrontals into a large scale, clearly the most prominent on each side of the head. Only the Mpwapwa sample retains a small ocular scale and the small supralabial below it, giving it a labial formula of 3/2. All the other samples have the gape bordered by slightly less than two supralabials and two or slightly more than two infralabials. All the southern forms have the frontals as a pair of small sub-triangular scales in broad contact on the mid-dorsal line and in point or extended lateral contact with the second supralabials. Loveridge's fig. 23, 1941, is in error in showing the frontals (his "post-frontals") fused in the Rondo material. In the Mpwapwa and Mikindani samples the frontals are followed by a single pair of enlarged, wider-than-long shields along the dorsal midline which are kept from contact with the post-supralabials (= enlarged segments posterior to and in line with supralabials, cf. Gans and Alexander, 1962) by one or two medium-sized to small shields. In almost all cases, these scales also contact the dorsal edge of the post-supralabials.

A few specimens also show some slight enlargement of the mid-dorsal segments of the first body row posterior to the parietal, part of the enlargement being longitudinal, which produces a scalloping of the posterior edge of the second parietal.

The anterior post-supralabial is ordinarily very much the larger and the posterior relatively small. The length of the first post-supralabial varies. It is relatively short in the material from Mbanja, Mikindani, Nanguruwe, and Newala, and significantly longer in most Rondo Plateau specimens where this scale is often as long as tall. In a few instances (approximately 10 per cent when azygous specimens are included) the first and second post-supralabials are fused. [This condition is shown in the lateral, but not the dorsal view of the specimen illustrated by Loveridge (1941, fig. 23) who calls these scales temporal and posterior temporal respectively. He was apparently misled by this illustration into concluding (1962:3) that the Newala material had a "quite distinctive arrangement of head shields."]

In most specimens the two first post-supralabials correspond to the lateral scale segments of the first two body annuli. Some 5 per cent of the Rondo material has these segments corresponding to the anterior three body annuli, a condition not otherwise observed. This suggests that in this species there may be a tendency for an enlargement of the area on the dorsal surface of the head that is covered with enlarged scales.

SEGMENTATION OF LOWER JAW

The mental is large, more or less V-shaped, enclosed between the enormous first infralabials which are by far the largest segments on the lower jaw, and followed by the small, rectangular post-mental. The second infralabials are extremely small and their posterior edge terminates at the level of the angulus oris, usually slightly anterior to the posterior edge of the second supralabials. They are followed by one or two first infralabials with the sutures of this row often running diagonally rather than at right angles to the long axis of the body. Medially, the first and second infralabials are in contact with one or two pairs of enlarged malar and "post-malar" shields.

Two, very rarely three, rows of small segments lie between the malars. Segments of the first row number two for the Mikindani sample, four for the Mpwapwa sample, and three for all others (with the exception of two specimens from the Newala-low sample.) The median (azygous segment) is generally somewhat enlarged and may be the only one in contact with the postmental. The second row of postgenials generally has four segments. The frequency of this is 100 per cent for the samples for Mbanja, and about 90 per cent for the Newala-low, Nchingidi and Mtene groupings. In contrast, more than 30 per cent of the Newala-high sample has counts of three and five, as has almost 20 per cent of a sample taken by Ionides at Rondo.

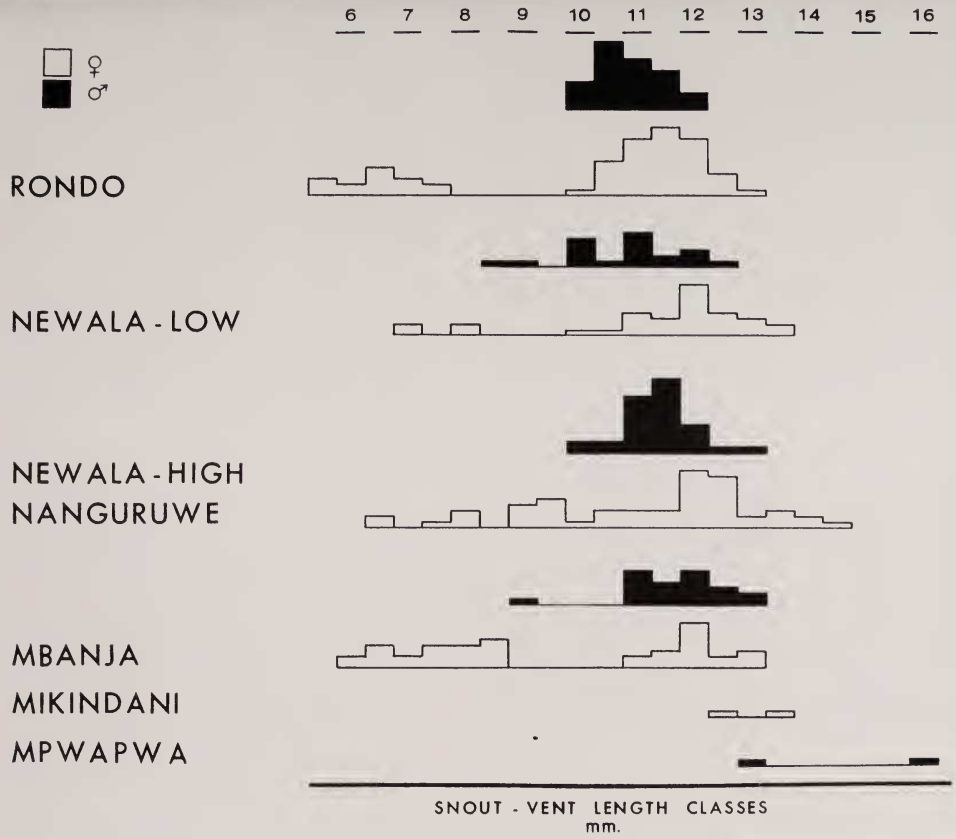
BODY PROPORTIONS

Sexual dimorphism: The analysis of body proportions proved exceedingly interesting because it yielded the first instance of amphisbaenid sexual dimorphism in characters other than the degree to which the precloacal pores are expressed (cf. Gans and Alexander, 1962).

Besides showing absolute sexual dimorphism in number of precloacal pores and in the number of segments in the pore-bearing row, these samples showed dimorphism in over-all size of the adult classes and in their regression lines for tail versus snout-vent length. The degree of sexual dimorphism in both these characters also showed geographic variation, and a greater adult size of females appeared positively correlated with a longer tail length of males.

Histograms of material from the several localities (fig. 5) indicate that, except for the unisexual Mpwapwa and Mikindani samples, and

Fig. 5. *Chirindia.* Histogram of all samples split according to presence or absence of precloacal pores.


6
7
8
9
10
11
12
13
14
15
16
♀
♂
RONDO
NEWALA - LOW
NEWALA - HIGH
NANGURUWE
MBANJA
MIKINDANI
MPWAPWA
SNOUT - VENT LENGTH CLASSES
mm.

the non-dimorphic Mbanja sample, the average snout-vent length of adult females is significantly greater than that of adult males. The Mbanja sample similarly shows no difference between male and female regression lines. The Nanguruwe and Newala-high samples show distinct, but overlapping, ranges of points. The Newala-low and the Rondo samples show almost no overlap in the lines for the two sexes. (fig. 6).

Hatchling size: Comparison of body proportions among samples of ectotherms capable of indeterminate growth poses interesting problems (Gans, 1959: 117; 1964:21-24). It is possible, however, to base tentative conclusions on samples compiled from available museum collections.

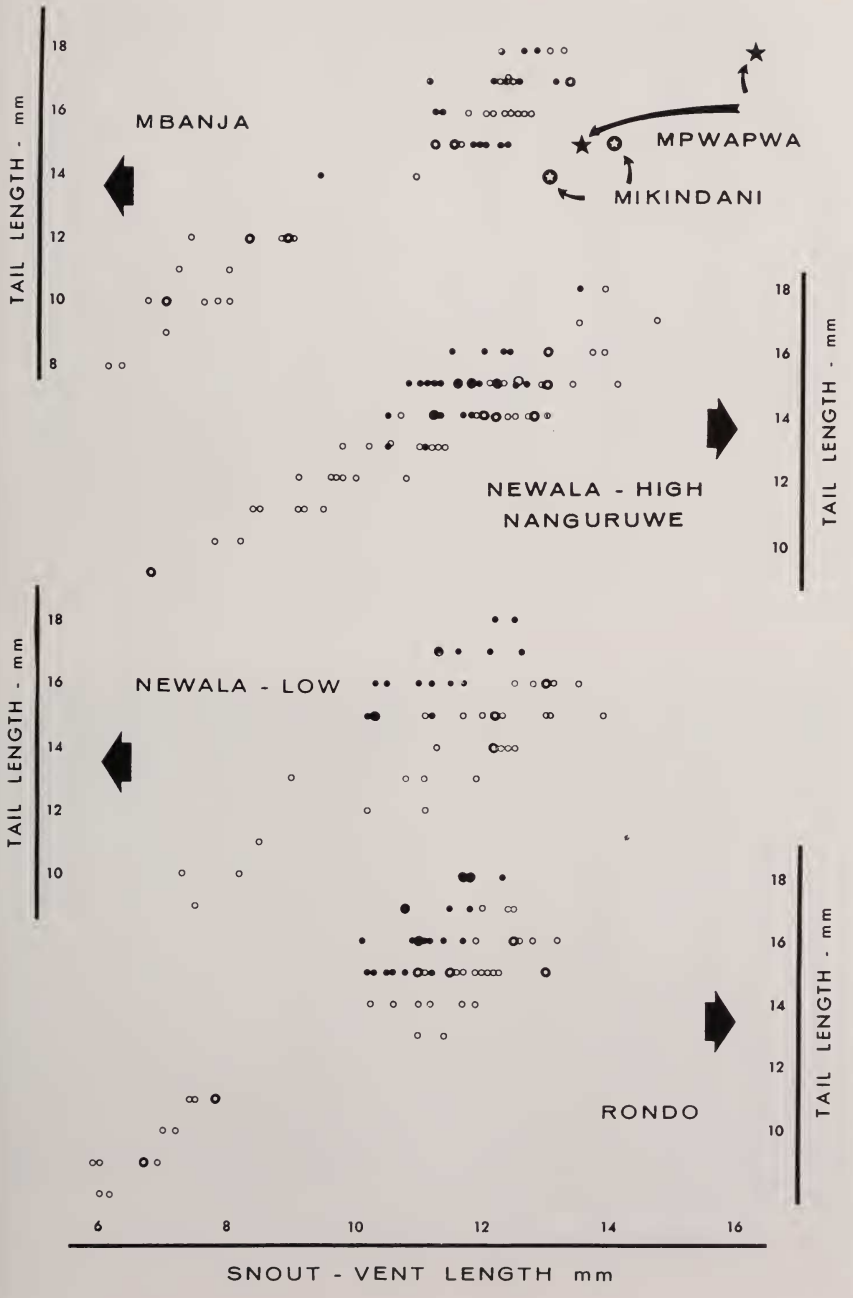
Comparison of hatchling size involves the assumption that representative samples were taken throughout the year. This is certainly not the case here since Ionides advises (personal communication) that in southern Tanganyika amphisbaenids may be taken only during the rainy season, which extends from January to May. The collection of juveniles in the Nanguruwe and Newala samples was too small to permit comparison. The Mbanja and Rondo samples contain numerous juveniles, and suggest that the Rondo sample has the smallest hatchling size, possibly with a snout-vent length 1 cm. less than that of the Mbanja sample.

Adult size: Among the males, the Mpwapwa specimens appear to attain by far the greatest size. The size of adult males from Mbanja, Nanguruwe, and Newala-high is much smaller and the sample shows good internal agreement. The Newala-low and Rondo males are somewhat smaller.

The adult females from Mbanja, Nanguruwe, Newala-high, and Newala-low occupy equivalent size classes, though the Newala-high sample has a significantly greater group of extremely large individuals. The females from Rondo appear to be somewhat smaller, while the Mikindani population may prove to be of greater average size.

Relative tail length: The Mpwapwa and Mikindani specimens clearly show the lowest relative tail length, differing significantly from that of

Fig. 6. *Chirindia.* Scatter diagram of the several samples, showing differences in relative tail-length of males and females. Solid symbols indicate males, hollow symbols indicate females; large dots and large circles indicate more than one coincident record.


TAIL LENGTH - mm
18
16
14
12
10
8
MBANJA
MPWAPWA
MIKINDANI
NEWALA - HIGH
NANGURUWE
NEWALA - LOW
RONDO
6
8
10
12
14
16
SNOUT - VENT LENGTH mm

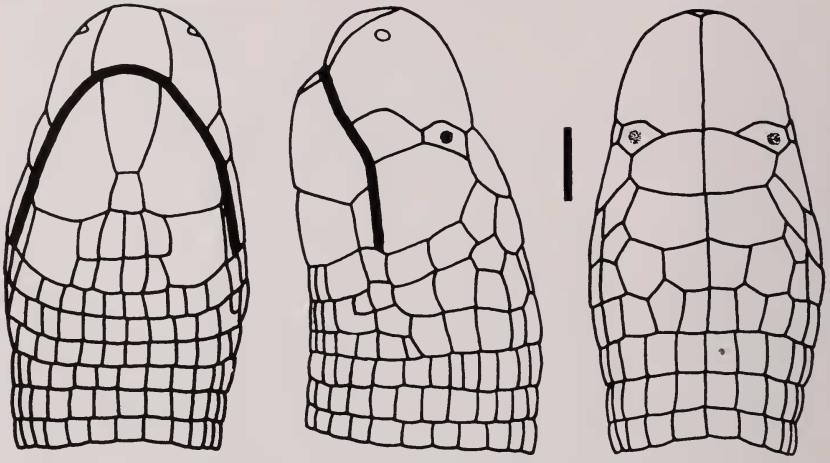


Fig. 7. *Chirindia mpwapwaensis.* Ventral, lateral, and dorsal views of the head of the holotype, MCZ 30767, from Mpwapwa, Tanganyika. The line equals 1 mm. to scale. (L. Allison, del.).

Fig. 8. *Chirindia mpwapwaensis.* Ventral, lateral, and dorsal views of the head of the holotype, MCZ 30767. Note the ocular, small first supralabial, and rounded snout.

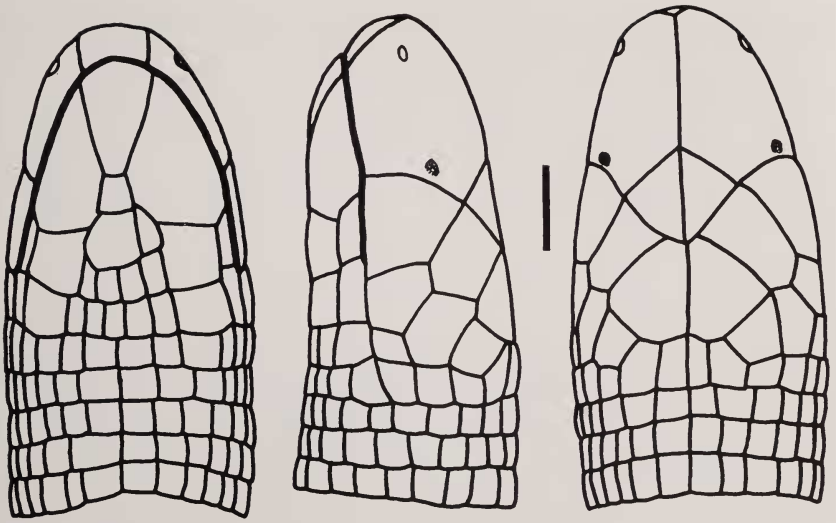


Fig. 9. *Chirindia orientalis.* Ventral, lateral, and dorsal views of the syntype, MCZ 21904, from Mikindani, Tanganyika. The line equals 1 mm. to scale. (L. Allison, del.).

Fig. 10. *Chirindia orientalis.* Ventral, lateral, and dorsal views of the head of the syntype, MCZ 21904. Note the head shield arrangement, especially the absence of an ocular.

both males and females of the Mbanja sample. The regression line of the Mbanja sample is in fair agreement with that for male specimens from Nanguruwe, Newala (high and low), and Rondo, although the latter contains a sizeable fraction of males with slightly longer tails.

Differences among the relative tail length of the females in the four large samples thus correlate well with the degree of sexual dimorphism shown in this character. The meaning of this phenomenon is not clear.

The Species Pattern

Comparison of the summarized data indicates that the Mpwapwa sample is clearly the most distinct. The specimens show minimal fusion of cephalic segments and retain an ocular and a third supralabial. The head is rounded, the size of individuals is greatest among the forms considered, and the relative tail length is lowest. The sample also shows differences in number of segments to a midbody annulus, in number of caudal annuli, in level of autotomy annulus, and in chin-segment arrangement. The degree of difference suggests that these specimens were sampled from a distinct, though allopatric, species, for which the name *mpwapwaensis* (Loveridge, 1932) remains available.

The Mikindani sample most closely resembles that from Mpwapwa. Its specimens have the same rounded head shape, limited fusion of segments in the occipital region, and chin-segment arrangement. The sample differs from that taken at Mpwapwa in the nature of the cephalic segment pattern, in number of segments to a midbody annulus, number of caudal and preautotomy level annuli, and probably in relative tail length. These differences and the distance between the two sample localities (coupled with their absence? in the intermediate zone) suggest that the two samples be treated as specifically distinct. The Mikindani sample also differs drastically from all others taken in southern Tanganyika in the characters shared with *mpwapwaensis*, and relative tail length. It also shows significant differences from each of the other samples in various combinations of meristic characters. The sample is then considered to represent a distinct species for which the name *orientalis* (Sternfeld, 1911) is available.

The remaining samples are composed of specimens with pointed, rather than rounded heads and otherwise show considerable agreement in general appearance. The key to their systematic characterization lies in the Newala sample which though collected in essentially the same area is clearly bimodal in number of body annuli, number of segments

to a midbody annulus, and number of caudal annuli, and shows lesser degrees of associated differences in adult size, relative tail length and site of autotomy level. The diversity of characters involved makes it unlikely that the Newala sample represents a single polymorphic species. Mr. Ionides advises that most of the specimens were taken while turning the earth for cultivation within 100 yards of his house. Yet the collecting dates suggest (table 1) some population difference in ecology or activity pattern, as most Newala-low specimens were taken during January and February, and the Newala-high specimens during March.

TABLE 1

COLLECTING DATES FOR SPECIMENS TAKEN BY C. J. P. IONIDES AT NEWALA

Dates	"Newala-low" (*rondoensis*)	"Newala-high" (*e. nanguruwensis*)
Jan. 17-19, 1961	5	0
Jan. 25-31, 1961	21	0
Feb. 1-11, 1961	19	0
Feb. 13-20, 1961	4	4
Feb. 26-28, 1961	7	3
Mar. 1-6, 1961	1	71
June 24, 1961	1	0

Since all these items suggest the existence of two sympatric but non-interbreeding populations at Newala, the Newala specimens are here considered to have been sampled from two distinct species. The comparison of body annuli indicates that the Rondo sample is in general agreement with Newala-low and the samples from Nanguruwe and Mbanja with Newala-high.

The Newala-low and Rondo samples show more or less significant differences in number of caudal annuli, site of autotomy level, regression of tail on snout-vent length, degree of sexual dimorphism, size of adults, and head-segment arrangement. These generally permit assignment of sizeable samples, but the overlap is sufficient to prevent assignment of more than 50 per cent of individuals. This suggests that we are dealing with two partially differentiated populations of a single species. Two names, *rondoensis* (Loveridge, 1941) and *newalaensis* (Loveridge, 1962), belong to this assemblage, and types of both were used in the analysis. The second of these names must then be placed in the synonymy of the first.

The Newala-high and Nanguruwe samples differ only in number of caudal annuli and in the level of the autotomy annulus, again suggesting that they represent local (altitudinal?) variants of a single species. Both samples differ significantly from the Mbanja sample in number of caudal annuli, level of autotomy annulus, and presence of sexual dimorphism (and associated factors). Some 85 per cent of the Mbanja sample have a distinct number of segments to a midbody annulus, and the remainder agree with the count seen in the Nanguruwe-Newala sample. The resemblances suggest that the populations are conspecific. The differences indicate that some considerable degree of geographical and possibly altitudinal differentiation has taken place. Unfortunately there is no information on possible geographically intermediate populations. In its absence we recognize the forms as races of a single species, with the name *ewerbecki* (Werner, 1910) available for the coastal, and the name *nanguruwensis* (Loveridge, 1962) available for the inland population.

Fig. 11. *Chirindia ewerbecki ewerbecki.* Ventral, lateral, and dorsal views of the head of MCZ 47950, from Lindi, Tanganyika. Note the large head shields and rounded snout.

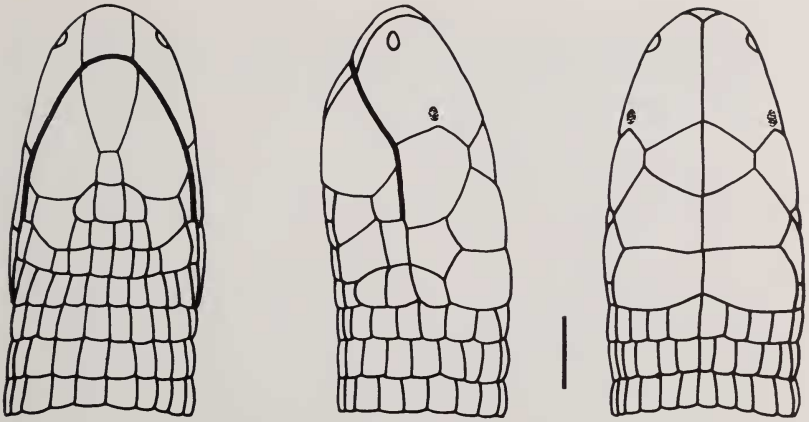


Fig. 12. *Chirindia ewerbecki nanguruwensis.* Ventral, lateral, and dorsal views of the head of BM 1961.535-596 (Ionides 9249), from Newala, Tanganyika. The line equals 1 mm. to scale. (L. Allison, del.).

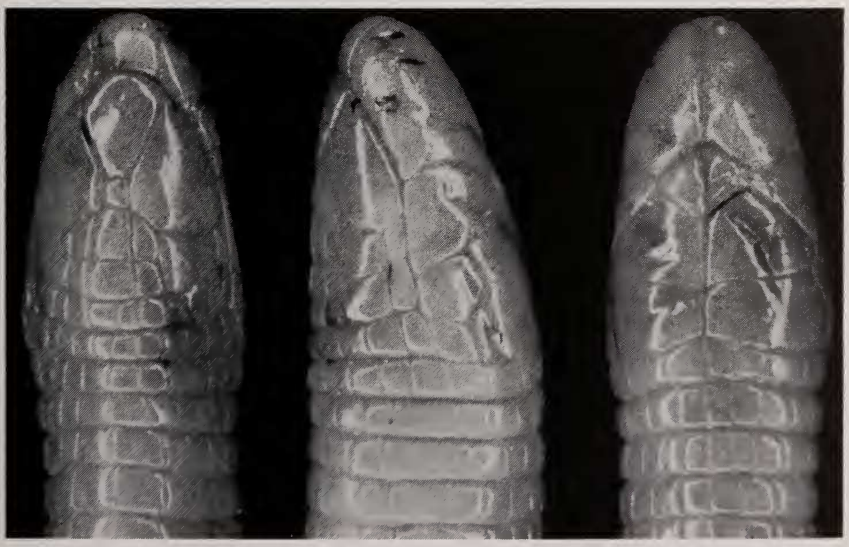


Fig. 13. *Chirindia ewerbecki nanguruwensis.* Ventral, lateral, and dorsal views of the head of the holotype, MCZ 67010, from Nanguruwe, Tanganyika. Note the pointed snout.

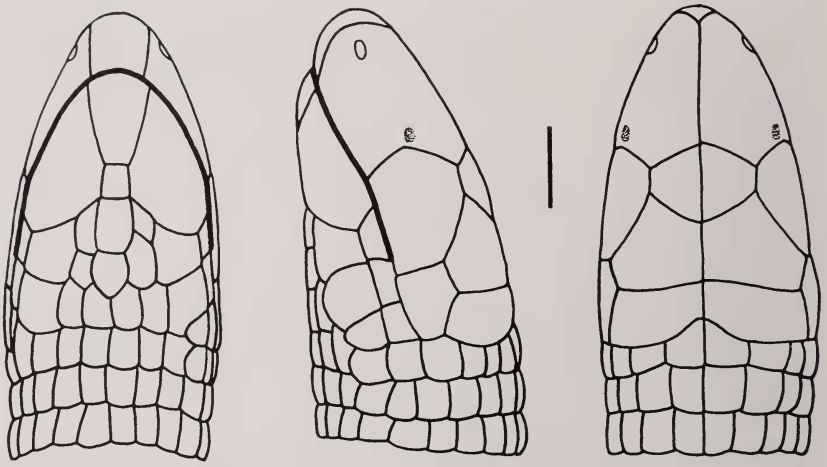


Fig. 14. *Chirindia rondoensis*. Ventral, lateral, and dorsal views of the head of CG 1856, from Rondo Plateau, Tanganyika. Note the fused first and second postsupralabials in the lateral view. The line equals 1 mm. to scale. (L. Allison, del.).

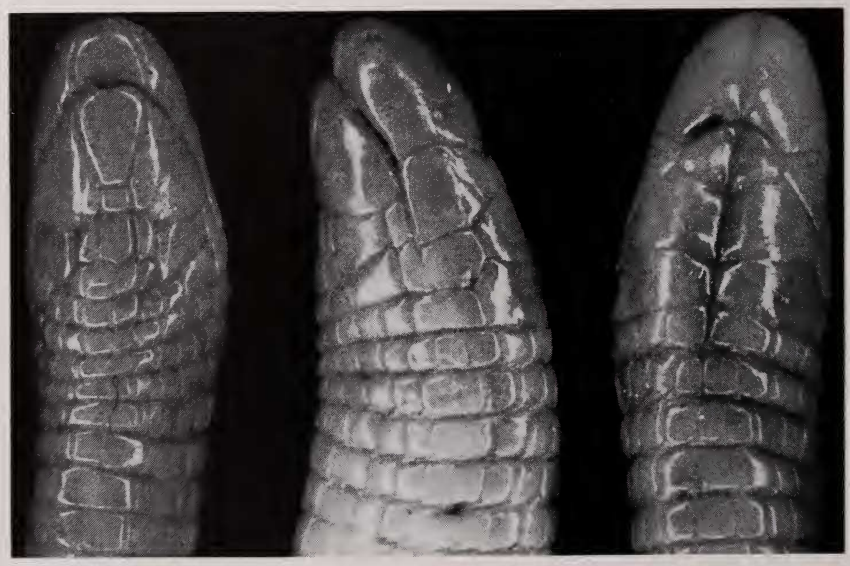


Fig. 15. *Chirindia rondoensis*. Ventral, lateral, and dorsal views of the head of the paratype (*newalaensis*), MCZ 67009, from the Makonde Plateau, Newala, Tanganyika.

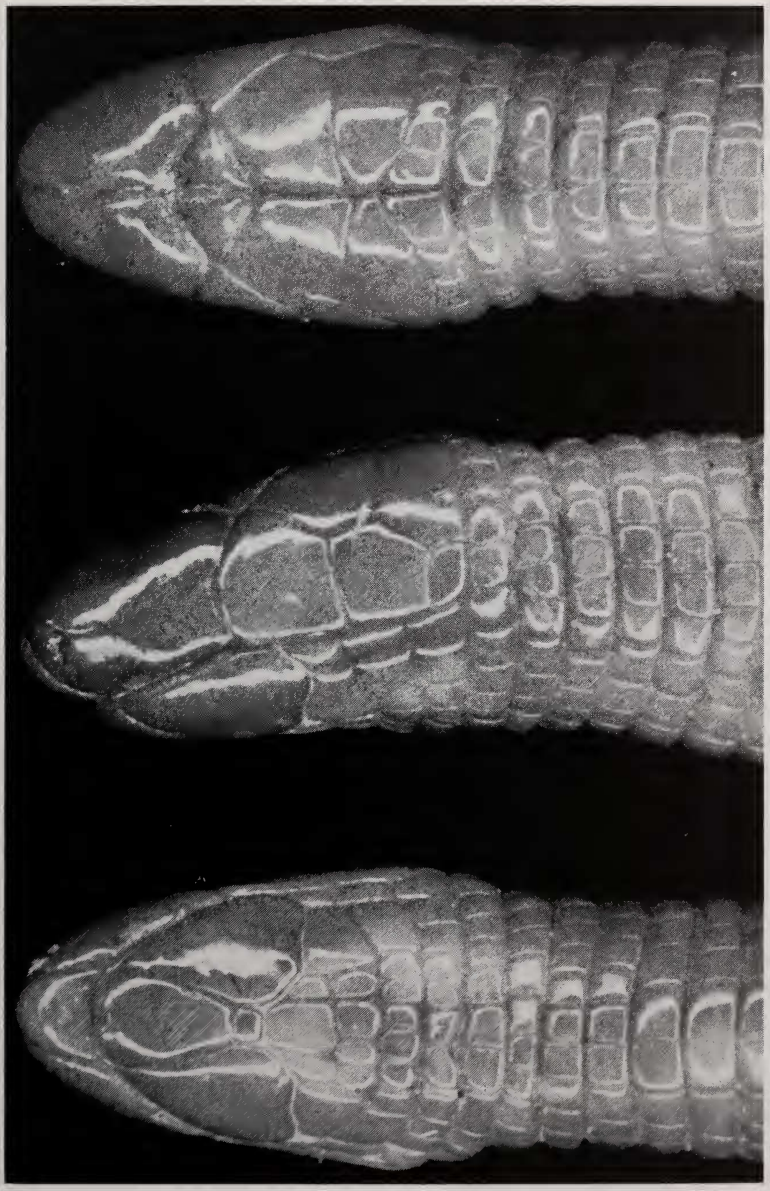


Fig. 16. *Chirindia rondoensis*. Dorsal, lateral, and ventral views of the head of the holotype (*rondoensis*), MCZ 47591, from Nchingidi, Rondo Plateau, Tanganyika. Note the length of the anterior post-supralabial.

Fig. 17. *Chirindia.* Dorsal (left) and ventral (right) views at midbody to show size and pigmentation of segments of *mpwapwaensis* holotype MCZ 30767 (top), *orientalis* syntype MCZ 21904 (middle), and *e. ewerbecki* MCZ 47950 (bottom).

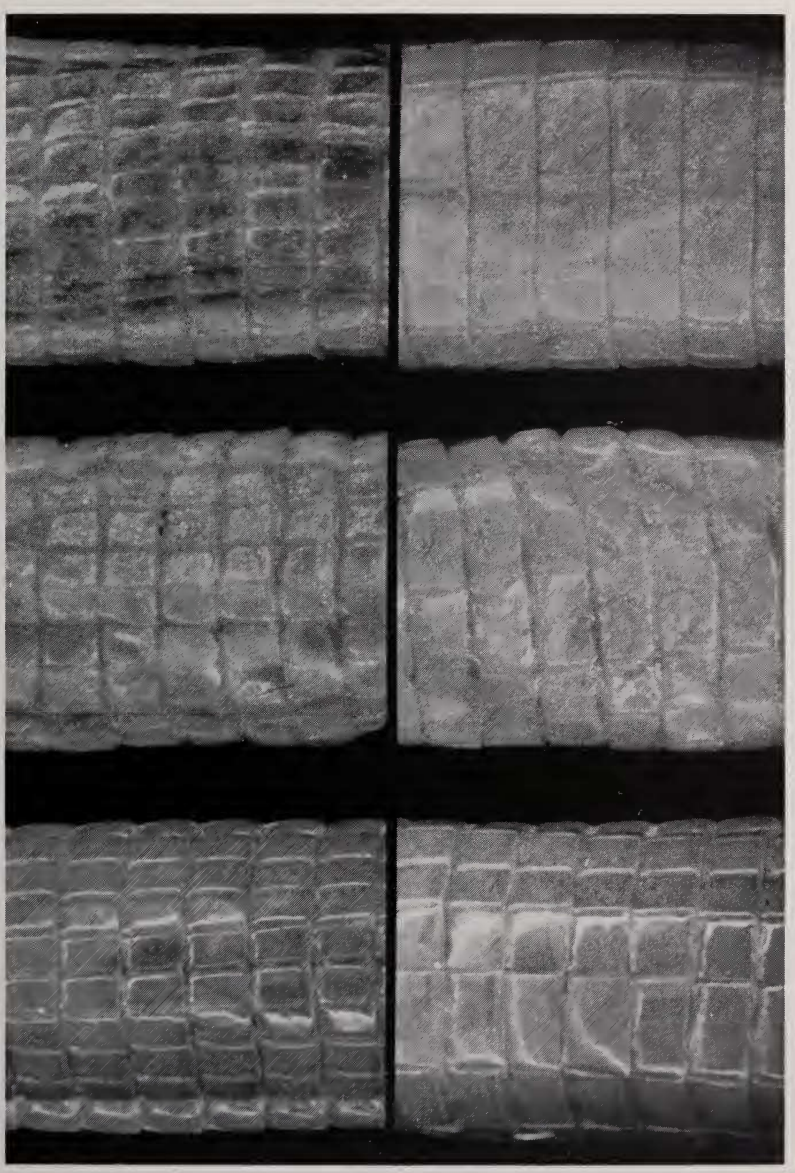


Fig. 18. *Chirindia.* Dorsal (left) and ventral (right) views at midbody to show size and pigmentation of segments of *ewerbecki nanguruwensis* holotype MCZ 67010 (top), *rondoensis* (holotype of *newalaensis*) MCZ 67005 (middle), and *rondoensis* (holotype of *rondoensis*) MCZ 47591 (bottom).

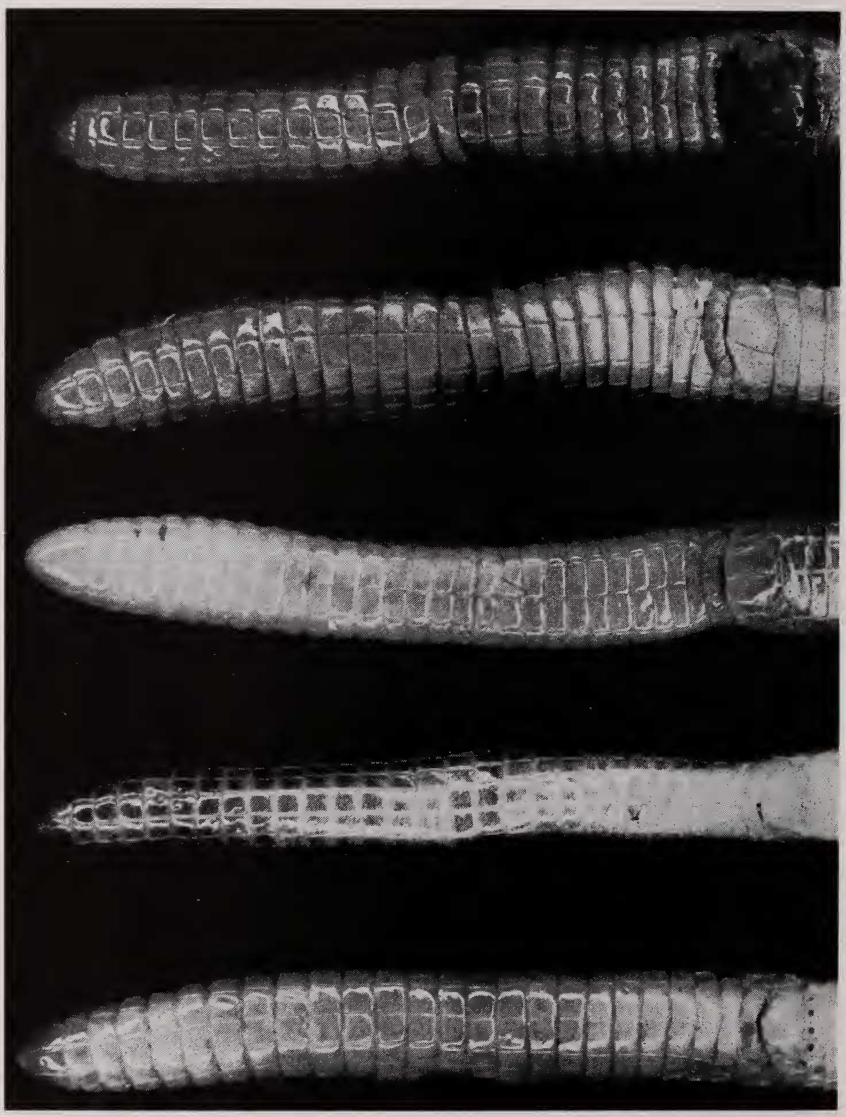


Fig. 19. *Chirindia*. Ventral views of the cloaca and tail to show segment arrangement, autotomy constriction, and pigmentation. From top to bottom, *mpwapwaensis* holotype MCZ 30767, *orientalis* syntype MCZ 21904, *e. ewerbecki* MCZ 47950, *ewerbecki nanguruwensis* holotype MCZ 67010, and *rondoensis* holotype of *newalaensis* MCZ 67005.

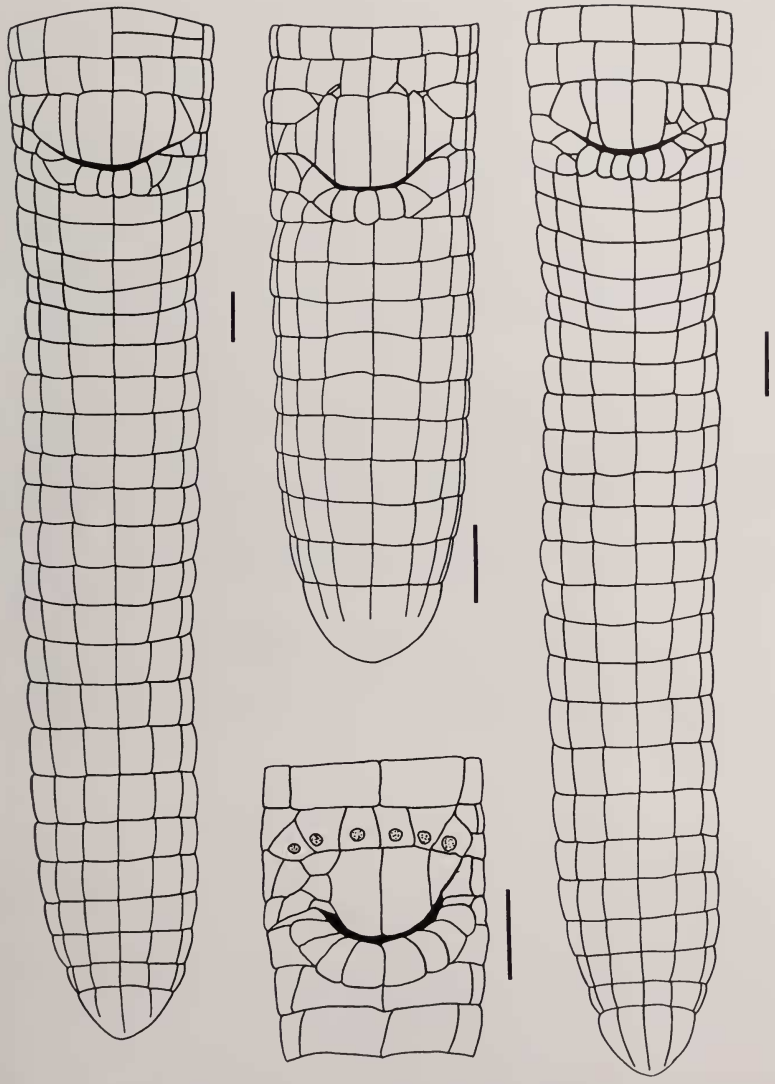


Fig. 20. *Chirindia rondoensis*. Ventral views of the tail and cloaca (female) of LCM R4168 (left) from Newala, Tanganyika; CG 1856 (top middle) from Rondo Plateau, Tanganyika; and BM 1961.535-596 (Ionides 9249) (right) from Newala, Tanganyika. Detail of male cloaca of CG 1886 from Mtene, Rondo Plateau, Tanganyika, showing relation of pores to precloacal segments (bottom middle). Lines equal 1mm. to scale. (L. Allison, del.).

KEY TO THE TANGANYIKA FORMS OF *Chirindia*

1. Head rounded; parietals not in lateral contact with post-supralabials; 2 or 4 segments in first postgenial row; tail shorter (fig. 6); adult size longer (fig. 5)....2

   Head pointed; parietals laterally in contact with post-supralabials; 3 segments in first postgenial row; tail longer (fig. 6); adult size shorter (fig. 5).....3

2. A distinct ocular; 3 supralabials; 4 postgenials in first row; 14+14 to 14+16 segments to a midbody annulus; 24 to 25 caudal annuli....*Chirindia mpwapwaensis*

   Ocular fused to nasal-prefontal-labials; 2 supralabials; 2 postgenials in first row; 12+12 segments to a midbody annulus; 23 caudal annuli....*Chirindia orientalis*

3. Body annuli 200 to 256; 10 segments in a midbody annulus ventral to (10 dorsal to) the lateral sulci; mostly with 22 to 25 caudals; adults very small (fig. 5); marked sexual dimorphism in adult size and relative tail length (fig. 6)..... .....*Chirindia rondoensis*

   Body annuli 253 to 282; 12 segments in a midbody annulus ventral to the lateral sulci; adults medium sized (fig. 5); sexual dimorphism in adult size and relative tail length present or not (fig.6).....(*Chirindia ewerbecki*) 4

4. Generally 12, sometimes (< 15%) 10 segments in a midbody annulus dorsal to the lateral sulci; generally 26 to 28 caudal annuli; autotomy level generally within the 10th to 12th postcloacal range; adult females smaller (fig. 5); no sexual dimorphism in adult size or relative tail length (fig. 6)..... .....*Chirindia ewerbecki ewerbecki*

   Ten segments in a midbody annulus dorsal to the lateral sulci; generally 23 to 25 caudal annuli; autotomy level generally within the 8th to 11th postcloacal range; adult females larger (fig. 5); marked sexual dimorphism in adult size and relative tail length (fig. 6).....*Chirindia ewerbecki nanguruwensis*

SUMMARY OF SPECIES

Chirindia mpwapwaensis (Loveridge)

Amphisbaena mpwapwaensis Loveridge, 1932:378.

Terra typica: "Mpwapwa, Ugogo, Tanganyika Territory." Holotype: MCZ 30767. Paratype: MCZ 30768.

LOCALITY RECORDS (known from the types only): *Tanganyika:* Ugogo, Mpwapwa (Barbour and Loveridge, 1929; Laurent, 1947; Loveridge, 1932, 1933, 1937, 1941, 1944a, 1944b, 1957; Vanzolini, MS.); MCZ 30767 (holotype), 30768 (paratype).

Chirindia orientalis (Sternfeld)

Amphisbaenula orientalis Sternfeld, 1911:246.

Terra typica: "Mikindani," Tanganyika. Syntypes[1]: BM 1935.2.8.7—RR 1946.8.2.18; MCZ 21904; ZMU 22067, 22407 (2 ex.), 22408 (2 ex.), 22409.

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[1] Sternfeld listed only 7 syntypes; it is not clear why there now seem to be 8.

LOCALITY RECORDS: *Tanganyika:* Southern Province, Mikindani (Barbour and Loveridge, 1929; Laurent, 1947; Loveridge, 1932, 1937, 1941, 1942, 1957; Nieden, 1913; Sternfeld, 1911; Vanzolini, 1951; MS. figures quadrate); MCZ 21904 (syntype), 47905.

Chirindia ewerbecki ewerbecki Werner

Chirindia ewerbecki Werner, 1910:37.

Terra typica: "Banja, 3 Stunden nördlich von Lindi, Deutsch-Ostafrika, an einer Meeresbucht. Boden schwarzsandig, nicht frei von Salz." = Mbanja, 10 miles north of Lindi, Tanganyika (Loveridge, 1941:393). Holotype: Formerly HM. Destroyed.

LOCALITY RECORDS: *Tanganyika:* Southern Province, Mbanja (FitzSimons, 1939; Jollie, 1960 on skull; Laurent, 1947, Loveridge, 1937, 1941, 1942, 1957, 1962; Vanzolini, MS.; Zangerl, 1944 figures skull, 1945 vertebral column and girdles); BM 1947.3.1.8—1947.3.1.9; MCZ 47906-47947, plus 19 unnumbered specimens. Lindi (Loveridge, all above citations); MCZ 47950.

Chirindia ewerbecki nanguruwensis (Loveridge)

Amphisbaena (Cynisca) nanguruwensis Loveridge, 1962:5.

Terra typica: "Nanguruwe, ca. 1600 feet, 8 miles south of Newala, Newala District, Southern Province, Tanganyika." Holotype: MCZ 67010. Paratypes: MCZ 67011-67019 (+97 specimens[1]).

LOCALITY RECORDS: *Tanganyika:* Southern Province, Nanguruwe (Loveridge, 1962); MCZ 67010 (holotype), 67011-67019 (paratypes). Newala, BM 1961.535—1961.621.

Chirindia rondoensis (Loveridge)

Amphisbaena rondoensis Loveridge, 1941:394.

Terra typica: "Nchingidi, 2,700 feet, Rondo Plateau, Southern Province, Tanganyika Territory." Holotype: MCZ 47951. Paratypes: AMNH 64274-64275; BM 1947.3.1.6—1947.3.1.7; CNHM 73372 (per Marx, 1958:452); MCZ 47952-47999; UIMNH 41495; UMMZ 86367 (2 ex.) (Peters, 1952:25).

Amphisbaena (Cynisca) newalaensis Loveridge, 1962:4.

Terra typica: "Newala, on the edge of the Makonde Plateau at 2600 ft., . . . Newala District, Southern Province, Tanganyika." Holotype: MCZ 67005. Paratypes: MCZ 67006-67009; BM 1962.172—1962.176.

LOCALITY RECORDS: *Tanganyika:* Southern Province, Lindi District, Rondo Plateau, C.G. 1833, 1838-1881, 1887-1890, 1892, 1894. Rondo Plateau, Nchingidi (type series), *rondoensis* (Barbour and Loveridge, 1946; Kesteven, 1957 skull and cephalic muscles; Laurent, 1947; Loveridge, 1942, 1957, 1962; Vanzolini, MS.); AMNH 64274-64275; MCZ 47951 (holotype *rondoensis*), 47952-47965, 47967-47986, 47989. Rondo Plateau, Mtene, BM 1958.1.3.29—1958.1.3.30; CG 1832, 1835-1837, 1882-1886. Makonde Plateau, Newala (Loveridge, 1962); BM 1961.622—1961.657; LCM R4158-R4170; MCZ 67005 (holotype *newalaensis*), 67006-67009 (paratypes *newalaensis*).

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[1] Loveridge mentions 106 paratypes of which nine are in the Museum of Comparative Zoology. It is not clear what happened to the remainder.

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